Report of Survey Conducted at

DIGITAL EQUIPMENT CORPORATION
WESTFIELD, MASSACHUSETTS
MAYNARD, MASSACHUSETTS

AUGUST 1992

BEST MANUFACTURING PRACTICES

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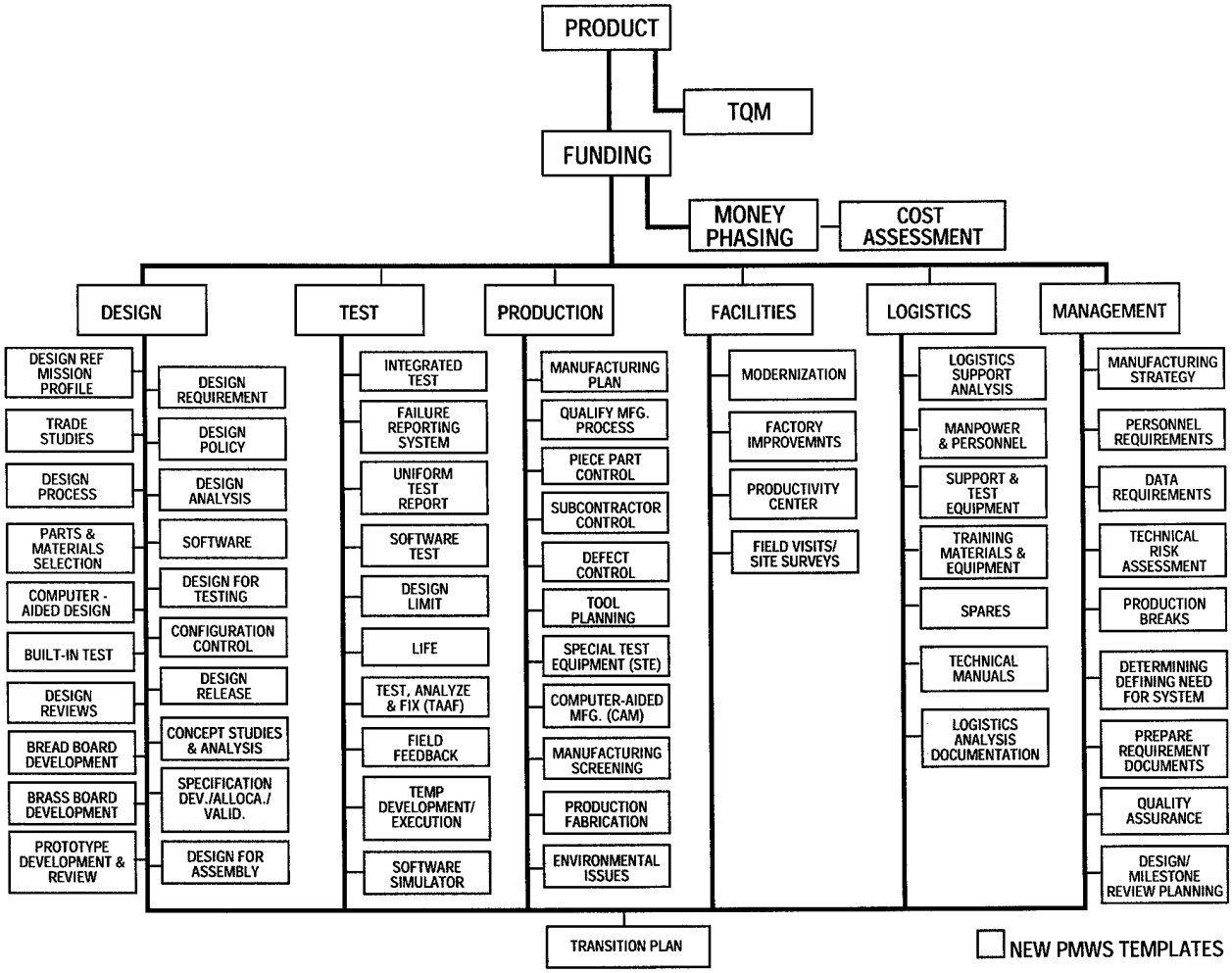
"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



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SECTION 1

EXECUTIVE SUMMARY

1.1 BACKGROUND

The Navy's Best Manufacturing Practices (BMP) team conducted a survey at the Digital Equipment Corporation (DEC) in Westfield, Massachusetts and Maynard, Massachusetts the week of 10-14 August 1992. The purpose of the DEC survey was to review and document its best practices and investigate any potential industry-wide problems. The BMP program will use this documentation as an initial step in a voluntary technology sharing process among the industry and government.

1.2 BEST PRACTICES

The best practices documented at DEC are detailed in this report. These topics include:

Item	Page
Total Quality System DEC Enclosures maintains an integrated quality system designed to ensure product conformance to specifications.	10
ISO 9000 Implementation and Registration Preparing for ISO 9000 registration helped to give discipline and focus to DEC's emerging worldwide enclosures business during a transition period and also provided the foundation for an effective quality system. As a result, DEC Enclosures was registered to ISO 9002 in May 1992.	11
Productivity Improvement Teams The emphasis of Enclosures Business cross-functional Productivity Improvement Teams is on timely implementation of solutions.	11
Employee Development Education Program Enclosures Business has implemented an Employee Development Education Program that focuses on employees becoming certified in specialty areas through nationally recognized organizations.	12
Employee Assistance Program As part of the effort to maintain a healthy work force, Enclosures Business established an Employee Assistance Program to provide employees professional services and referrals required to help resolve physical and emotional difficulties, family problems, substance abuse, and financial and legal concerns.	12
Indirect Labor Participation Program Under this program, each indirect labor employee performs four hours per week in a direct labor operational position on the factory floor.	13
Information Systems and Technology The Information Systems and Technology department provides a reliable, predictable, and secure computing environment which is a foundation of the business.	13

1.3 INFORMATION

The following information items are detailed in this report:

Item	Page
Standard Visual Aid for Material Finish DEC developed a visual aid standard to define material finish requirements.	15
Six Sigma Manufacturing Six Sigma manufacturing is being implemented and has resulted in more effective process capability studies, clearly defined requirements, easier implementation of design changes, and improved communication between design, manufacturing, and the customer.	15
Engineering Change Orders To ensure timely implementation of engineering change orders, Enclosures Business revised its ECO issue process to coordinate all key organizations, thereby guaranteeing that the latest revision parts and products are being manufactured.	15
Work Cell Teams The Enclosures Business site has instituted work cell teams in its production efforts with results of reduced cycle time on the production of parts within the cell by 80%, reduced WIP, and improved material handling efforts.	16
Continuous Improvement Teams Continuous Improvement Teams are empowered to identify a problem area and take corrective action to correct the problem.	16
Manufacturing Resource Planning MRP II standards establish a basic discipline baseline for understanding and refining the process of achieving the required production output consistent with the corporate business philosophy.	16
Team Evolution Still in an early stage, teams have focused on composition and operations and are experimenting with organizational and reporting changes.	16
Cycle Time Reduction Program This program was initiated to achieve goals of reduced cost, increased customer satisfaction, and overall improvement in working environment.	17

SECTION 2
INTRODUCTION

2.1 SCOPE

The purpose of the Best Manufacturing Practices (BMP) survey conducted at the Digital Equipment Corporation (DEC) in Westfield, Massachusetts and Maynard, Massachusetts was to identify best practices, review manufacturing problems, and document the results. The intent is to extend the use of progressive management techniques as well as high technology equipment and processes throughout industry and government facilities. The ultimate goal of the BMP program is to strengthen the U.S. industrial base and reduce the cost of defense systems by solving manufacturing problems and improving quality and reliability.

A team of engineers accepted an invitation from DEC to review the processes and techniques used in its facilities located in Westfield, Massachusetts and Maynard, Massachusetts. Potential industry-wide problems were also reviewed and documented. The review was conducted at DEC on 10-14 August 1992 by the team identified in Appendix B of this report.

The results of BMP surveys are entered into a database for dissemination through a central computer network. The actual exchange of detailed data will be between companies at their discretion.

The results of this survey should not be used to rate DEC with other government activities, defense contractors, or commercial companies. The survey results have no bearing on one facility's performance over another's. *The documentation in BMP reports is not intended to be all inclusive of the activity's best practices.* Only selected non-proprietary practices are reviewed and documented by the BMP survey team.

2.2 SURVEY PROCESS

This survey was performed under the general survey guidelines established by the Department of the Navy. The survey concentrated on the functional areas of design, test, production, facilities, logistics, and management. The team evaluated DEC's Enclosures Business policies, practices, and strategies in these areas. Furthermore, individual practices reviewed were categorized as they relate to the critical path templates of DoD 4245.7-M, "Transition from Development to Production." DEC identified potential best practices and industry-wide problems. These practices and other areas of interest were discussed, reviewed, and documented for distribution throughout the U.S. industrial base.

The format for this survey consisted of formal briefings and discussions on best practices and problems. Time was spent on the factory floor reviewing practices, processes, and equipment. In-depth discussions were conducted to better understand and document the identified practices and problems.

2.3 NAVY MANUFACTURING TECHNOLOGY CENTERS OF EXCELLENCE

Demonstrated industry-wide problems identified during the Best Manufacturing Practices surveys may be referred to one of the Navy Manufacturing Technology Centers of Excellence. They are identified in Appendix C.

2.4 COMPANY OVERVIEW

Located in Westfield, Massachusetts, the DEC Enclosures Business encompasses 225,000 square feet with a staff of 600 employees in support of the total business. DEC Westfield, together with its facility located in Maynard, Massachusetts, provides sheet metal fabrications finishing and assembled enclosures from single tools to model, prototypes and high volume products. Westfield's fabrication and assembly flexibility is enhanced by CNC equipment under DNC control, design-to-manufacturing connectivity through electronic transfer, and a computer-controlled EPA compliant paint system.

In addition to Westfield's manufacturing capabilities, services offered through DEC Enclosures Business include the use of information technology to manage the business; sheet metal versus plastics analysis; concurrent engineering; material management; and integrated work cell manufacturing teams.

2.5 ACKNOWLEDGMENTS

Special thanks are due to all the people at DEC whose participation made this survey possible. In particular, the BMP program acknowledges the special efforts of Ms. Judy Maudlin and Ms. Ellen Boyle for enabling this survey to occur.

2.6 COMPANY POINT OF CONTACT

While the information included in this report is intended to be descriptive of the best practices and techniques observed, it is not intended to be all inclusive. It is intended that the reader will need more detailed data for true technology transfer.

The point of contact for this BMP survey is:

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SECTION 3
BEST PRACTICES

There were many notable best practices at DEC's Enclosures Business, and the survey team considered them to be among the best in industry and government.

3.1 FUNDING

MONEY PHASING

Financial Management System

Digital Equipment Corporation's corporate headquarters instituted a formatted and defined structure for financial management to standardize, centralize, and control all aspects of DEC's worldwide financial accounting activities. This Financial Management System is a shared service developed by DEC, and the financial architecture and Financial Management Center concept was determined to be best-in-class in a study conducted by AT Kearney Consulting.

Before implementing the DEC Financial Management System, financial accounting and reporting differed from site to site. Systems were unnecessarily replicated, cumbersome reporting duplication occurred, and the system was not flexible enough to react to reorganizations. DEC's rapid growth of 25% to 30% per year and its size of over 100,000 worldwide personnel contributed to the undesirable financial management arrangement. DEC recognized that this type of business environment needed to be better, faster, and less expensive.

A Financial Management System evolved to provide shared services to all sites on an international network. All U.S. and North American sites are operational on the system, and European and Asian sites are undergoing planning and implementation. Financial accounting and reporting activities served by the system include general ledger, fixed assets, accounts payable, employee disbursements, travel, revenue, payroll, invoicing, inventory, and project accounting.

This system provides improved data quality, timely and consistent data, user friendly management tools to manipulate the data, and improved analytical tools and processes to aid in decision making. This successful DEC Financial Management System is being marketed as an important financial management tool outside of DEC, with possible commercial, government, national, and international applications.

3.2 DESIGN

DESIGN POLICY

Integration of Technology Development

DEC developed a technology integration process that has successful application in the ever-changing technological environment. DEC brought together all required major manufacturing disciplines needed to produce and deliver quality products.

The process evolved out of a competitive need by reducing time-to-market (TTM), lowering cost of new product introduction, and maximizing the use of existing technologies. The integration process uses a team-based approach that develops a product from concept to manufacturing through flexible manufacturing solutions. The result is a product that requires only minor changes after it reaches manufacturing. This dynamic process requires a core team of approximately four members representing the engineering and manufacturing departments to develop the product. Major changes at DEC were needed including new training, behavioral changes, process changes, and discarding the practice of design "tossing it over the wall" to manufacturing.

DEC has not only realized intangible benefits of improved communication through the team approach, but has experienced significant schedule impact by reducing TTM by up to 75% and reducing product development cost by 50%. The tangible side of improved communications was a substantially reduced number of engineering change orders which in one case went from 50 to just four.

DESIGN PROCESS

Rapid Prototyping

DEC recognized the need to become more competitive in reducing TTM for new products. To help accomplish this, DEC has implemented a new end state material rapid prototyping methodology. During the past year, it has proven to be a comprehensive design/qualification to prototype/manufacturing tool.

Prior to rapid prototyping, DEC's method of proofing a design concept was very mechanical, paper driven, sequential, and inflexible in meeting today's demands for new

product development. In order to create a meaningful (end state material) physical representation of a new product, enhancements were required.

DEC developed a rapid prototype tooling process that utilizes a data driven environment, automation, standardization of processes and tooling, and readily adapts to new technologies, process and material changes. End state material prototypes can now be produced in 2.5 weeks to 3.5 weeks, at 30% less cost, while reducing overall TTM by 50-70%.

DEC has realized a significant impact through the use of rapid prototyping. It promotes concurrent engineering, facilitates design for manufacturing, supports key design analysis, provides a cost effective design-through-manufacturing tool, and enables faster delivery of new products to the customer.

Concurrent Engineering

Concurrent engineering is another tool used to move a product from concept to manufacturing as quickly and cost effectively as possible. Concurrent engineering is viewed company-wide as a product development process that unifies personnel and their tools from various disciplines into teams. DEC maintains that "passing" work from one discipline to another is inefficient as it not only separates people but also their ideas.

To address the task of unification, DEC used several tools and techniques. For example, software was selected that could perform different functions and could efficiently communicate with other software. The Digital Computer network DECnet links design with production, and all computer information is transferred through a hardware link. The network links DEC inside buildings as well as worldwide to all facilities.

Teams consisting of core members from different disciplines work on each product development, and the team is tailored for each product. With a project leader as the focal point, each core member selects people from his or her discipline field; the core team members also have decision authority. Collocation provides the project team a unified and motivated attitude.

Design and production personnel have established some cost and time saving methods. Design guidelines are used to reduce tooling and setup costs in the production area. Product part count and product assembly are simplified to lower assembly times. Designing in metrics reduces variations in products that will be sold worldwide. Standardizing product materials such as the thickness of sheet steel has reduced the cost of inventory.

The customer is also an important part of product development. Potential customers are solicited in the product concept stage for input. In this way, the customer is assured delivery of what he wants and not what DEC thinks he may need.

DEC applies concurrent engineering practices to shorten TTM and lower the product development costs. Recent projects have shown that product development time from concept to prototype could be reduced by 50%.

COMPUTER-AIDED DESIGN

CAD + CAM = Total CAE

DEC recognized the need to integrate CAD and CAM to reduce lead time for new product-to-market concepts. By capitalizing on its position as an original equipment manufacturer of computers and computer accessories, DEC has been able to integrate CAD and CAM to form a total CAE environment. Solid modeling, wire frame, drafting, and manufacturing software packages must meet a standard for implementation in DEC's working CAE environment. Software packages used include AUTOCAD, SDRC/IDEAS, Parametric Technology/Pro-Engineer and Unigraphics, Vericut, BROVO 3, SMARTCAM, MASTERCAM, and Merry Mechanizations' SMP-81.

In addition to using the best available software, DEC uses a design – or "Pugh" – method which:

- Promotes individual design ideas
- Brings designs together
- Selects the best ideas from each concept
- Puts the best idea into one final concept. This final concept represents the best possible design since it characterizes ideas from more than one member of the design team.

DEC encourages personnel to keep an open mind and advocates learning from errors and iterates that working together promotes a "pull process" within the total organization.

3.3 TEST

FAILURE REPORTING SYSTEM

Corrective Action Simplified

The Enclosures Business has developed a corrective action system that is simple to use and produces effective results by incorporating the critical elements of problem and failure identification and classification, clear definition, timeliness, proper management, application of an analysis technique, and usability.

The Business realized that an effective corrective action system that could resolve problems in a uniform and timely manner was critical to the manufacturing process. Its previous system was disjointed, time consuming, cumbersome, lacked management emphasis, and tried to resolve problems away from the source. This new system was developed in the face of increasing competition, and a need to improve and conform to new requirements.

The present corrective action system classifies problems in three different ways – Level 1, Level 2, and Level 3. Level 1 problems are minor and usually quickly solvable; Level 2 problems are more serious, safety related, customer generated, repetitive or those elevated from Level 1. Level 3 is a cross-functional management review team that monitors the other levels.

It was understood that addressing major problems is normally not an issue since those problems clearly impact manufacturing and get immediate attention. Instead, the Business concentrated on the many individual small problems that occur daily but collectively may impart serious effects on manufacturing. A logging system at the work area was developed so operators can easily record problems. Supervisors then respond and fix the problems in the work area. Responsiveness is crucial because if problems are not corrected in a timely manner, the operators stop recording problems, and because the problems are minor, determine ways to work around them.

The corrective action system developed is simple and easy to use by the people that can identify the problems the best. It promotes an environment of continuous improvement, and it solves problems in an efficient, systematic, and cost effective manner.

3.4 PRODUCTION

SUBCONTRACTOR CONTROL

Supplier Certification Program

The Enclosures Business has implemented a supplier certification program aimed at developing an optimal number of qualified suppliers. The program offers part-level and company-level certification to participating suppliers.

The Supplier Systems Management Program (SSMP) is the company-level certification program and consists of three DEC standard document specifications – the Supplier Certification Policy to provide guidelines for SSMP qualification and maintenance of suppliers; Manufacturing Systems Assessment Procedure to provide a checklist for supplier certification; and the Supplier Quality Agreement to supply a format for an addendum to supplier contracts that define elements needed to obtain and maintain qualified status. The Ship-to-Stock (STS) program is the part-level certification program and is comprised of three DEC standard document specifications – Ship-to-Stock Process Steps, Ship-to-Stock Procedures, and the Ship-to-Stock Basic Agreement.

The implementation approach for these programs divides the suppliers by commodity area. Each commodity area has a commodity team comprised of purchasing and vendor quality engineering personnel as well as other key functional personnel that work together to manage and improve supplier performance within their assigned area. This team coordinates all supplier improvement efforts with other DEC divisions that share the same supplier. A Pareto analysis is performed to identify key suppliers within a commodity area. These key suppliers provide the highest number of parts, have excellent quality histories, and demonstrate a willingness to take corrective actions. The commodity team performs an SSMP audit at the candidate supplier facility. When all elements of the checklist are satisfied, the company becomes certified. Certification is formalized by contract language modification to existing supplier contracts or new Basic Order Agreements.

Since the inception of this program in 1991, 12 suppliers have achieved STS certification for 111 active parts, and seven suppliers have been certified under the SSMP program impacting some 438 active part numbers. Benefits of these efforts include capacity gains through reduced inspection requirements, cycle time reductions, and reduction in the quality costs.

TOOL PLANNING

Metrology Laboratory Consolidation

DEC's Enclosures Business has reorganized its metrology facility to better serve various facilities within Digital Equipment Corporation. Satellite calibration laboratories have been established at other DEC facilities which are staffed on a part-time basis by DEC Westfield personnel.

The satellite facilities typically calibrate simple measuring instrumentation. Equipment repairs and more sophisticated calibration is performed at the Westfield calibration laboratory. The associated costs of establishing a satellite calibration lab represent about one-twentieth the cost of constructing, equipping, and staffing a fully functional metrology laboratory. High level technical resources and part inventories are concentrated at the Westfield facility. The use of satellite facilities reduces or eliminates shipping cost, down time, and damage to equipment in transit.

Consolidation of the calibration laboratory has reduced inconsistencies in procedures and documentation across

facilities. Most DEC facilities throughout the Northeast are now using similar procedures and using identical documentation. The goal is to influence the Digital Corporation to follow a unified metrology procedure.

Preventive Maintenance

Until 1990 the DEC Westfield Enclosures Business did not have a preventive maintenance program that encompassed *all* manufacturing equipment used throughout their business. Prior to this, Preventive Maintenance was performed only on major pieces of manufacturing equipment on an intermittent/sporadic schedule. Technicians were becoming highly specialized in supporting specific types of equipment yet were unable to fully respond to service calls on equipment in other areas. And finally, there were no effective diagnostics for CNC servo-axis control systems.

DEC therefore developed a plan to assign responsibility to the Westfield engineering service department for the reliability of all manufacturing equipment and DEC equipment within the Enclosures Business domain. Key responsibility elements were to provide preventive maintenance and repair services to all DEC Enclosures Business manufacturing sites. This effort included over 300 major pieces of manufacturing equipment, 150 rivet tools and over 500 pieces of DEC equipment. Other responsibilities were to build and maintain a computerized record of all equipment under its control; maintain and publish weekly preventive maintenance lists; evaluate equipment acquisitions; provide consultation on usage and limitations of manufacturing equipment; and modify and upgrade equipment to meet manufacturing process requirements.

DEC has successfully integrated an organized, systematic preventive maintenance program that has become a model for the corporation. Manufacturing has benefited with reduced down time, cost reduction due to reduced vendor support service needs, and a more self-sufficient manufacturing process.

COMPUTER-AIDED MANUFACTURING

Standardized Programming

DEC Enclosures rectified a comprehensive problem of coordinating 16 different engineering groups that individually designed sheet metal products while located at various remote sites. DEC previously used a manual graphics layout system for creating an NC-tape/setup sheet, and the sheet was not directly connected to the actual design geometry.

The processes were time consuming, and TTM was extensive. With the old process, technicians used calculators to determine bend deductions to create flat blank layouts. The layouts were then redrawn and run through a program to select and place all punch tools on the layout. This information was then pushed through a program to generate a machine specific NC tape. These processes were prone to human error and dependent on programmer technique. Since DEC had multiple types or styles of machine tools, cross training of all NC programmers on all equipment became a problem.

To address these problems, DEC purchased a corporate contract for the SMP-81 sheet metal processing software. This software allows the CAD geometry IGES file to be directly imported into the programming environment. Consequently, there is a direct connection between the design geometry/data and the manufacturing data. Programmers systematically unfold the geometry using pre-determined/known bend deductions for the process tooling, eliminating the need for manual calculations, thereby reducing programmer-introduced error. The SMP-81 software also automatically selects punches that match features in the system generated/unfolded flat-blank-template from a standard tool table. This reduces programming time, other programmer introduced error, and variations in programming technique.

Nesting of multiples on a sheet of metal is done automatically and material utilization is optimized by SMP selecting the appropriate sheet size from a library of standard materials. SMP-81 has defined post processors for higher productivity and less machine specific training. Setup sheets are automatically created by SMP and are specific for the machine for which the program was created. A flat pattern layout, setup sheet, and NC tape generation that used to take four to five hours to create can now be accomplished in less than one hour.

One further refinement was added to the DEC process – installation of DNC capabilities to the machine network. This eliminated wrong tapes in wrong machines or wrong setup sheets, and damaged or lost tapes and setup sheets. Remaking these tapes and sheets created extra work for direct labor employees, NC programmers and management. NC programs and setup/turret sheets are libraried in DNC to the particular machines at which they are to be run. Confusion about which tape or setup/turret sheet is to be used where has been eliminated. The NC programs and tapes are no longer damaged or lost.

Revision control is also possible. Removal of out-of-revision NC programs and turret sheets is controllable and timely. New production introduction is more easily controlled and NC part program status is visible to everyone through the use of a status attached to each part program within DNC.

3.5 FACILITIES

FACTORY IMPROVEMENTS

Production Painting/EPA and State Regulations

DEC Enclosures improved its paint and waste operation in the production shop by installing an automated painting system. The previous four-booth, three-shift operation evolved to an eight-booth, one-shift operation while meeting EPA and state regulations. DEC reduced the volatile organic compound (VOC) emissions while increasing production line capacity.

Using the new system, the enamel painting (high solid paint) is conducted in the booths presented in Figure 3-1: (1-2 bell system), (3-4 electrostatic), (5-6 manual touch-up), and (7-8 robotic texturing). High quality parts are produced while cutting paint consumption to a minimum. The process requires two hours for a complete cycle of the overhead conveyor, and employees are not required to wear painting masks.

Paint sludge is dewatered using centrifuges. This process is the most effective means of monitoring and controlling the paint solid waste. The EPA and state regulations allow DEC 100 tons of VOC emissions per year. Since the new paint system has been installed, VOC emissions have been reduced from 77 tons to 14 tons per year. The sludge is then biologically treated by Laidlaw Environmental and safely disposed of, reducing disposal cost by $400 per drum.

The DEC waste water treatment system is monitored by the Automated Industrial Monitoring (AIM) security system which monitors the pH in waste water. The AIM system layers over the Allen Bradley Paint Line control system to interface DEC-developed software to distribute alarms to various stations and through E-Mail to key personnel. The system also automatically dispenses acid or base to balance waste water pH within the acceptable range. Alarm distribution is tailored to the needs of individual monitoring stations. The DEC facility is audited twice a year to ensure that the environmental standards are met.

PRODUCTIVITY CENTER

Pilot Production

Quick turnaround (QTA) and rapid pilot production (RPP) are critical aspects of DEC's Enclosures Business. When a customer requires a QTA or RPP part, a CAD drawing can be electronically transferred to the Westfield facility. Dedicated personnel will process the drawing through an IGES file and create an NC program and flat pattern layout using the SMP-81 software program and forward that file to the prototype shop for processing.

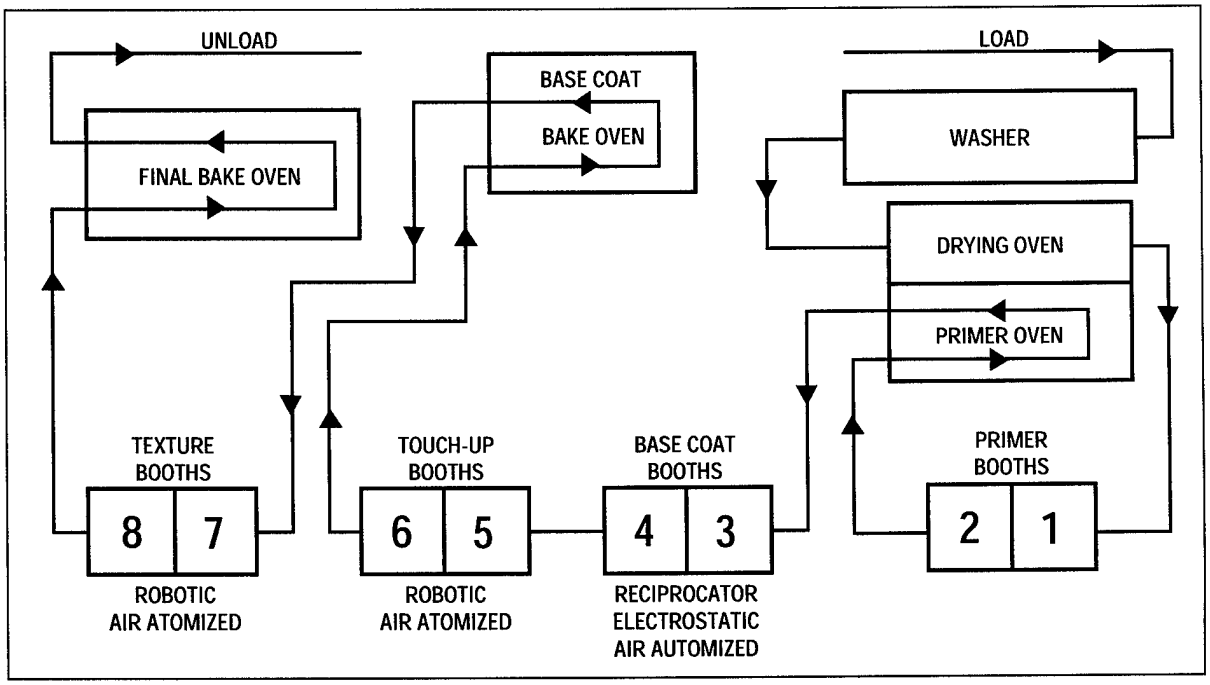

FIGURE 3-1. NEW PAINT LINE SCHEMATIC

A simple part can typically be processed to the shop floor in less than an hour. The shop floor processes the sheet metal part on the laser cutter and forwards the part to dedicated press brakes for forming. Agreements with local plating shops provide for same-day plating service.

The QTA/RPP area is staffed with one full-time NC programmer and one half-time NC programmer, two full-time and one half-time press brake operators, a welder, a part-time time punch press operator, and one assembler. Because of the work force diversity at this facility, other personnel can be pulled into the area as required. Customers using the QTA or RPP service receive 24-hour turnaround times on most parts.

3.6 LOGISTICS

TRAINING MATERIALS AND EQUIPMENT

Enclosures Training Department

Training strategy at DEC's Westfield site has undergone extensive evolution as site operations shifted from the systems business in 1985 to 1990 to the worldwide enclosures business in place since 1990. The Training department was a 15 person multi-shift, multi-purpose operation, and is now a two person operation. Downsizing and restructuring of the business necessitated focusing training efforts to address specific business and employee needs.

The training philosophy is based on achieving the appropriate balance of three critical success factors – business needs, employee needs, and training strategies. The business goals of delivery, quality, and technology establish the direction and priorities for the plant. Individual training needs are addressed in the areas of technical competence, advanced manufacturing and quality methodologies, and interpersonal development. Training is designed and delivered to meet both business and employee needs in the most appropriate and effective manner.

Training strategies which optimized the use of limited resources were developed to meet the demands dictated by rapid and sweeping business changes yet with full consideration of employee needs. Examples include the requirement to certify all operators in at least one category by June 1992; re-skilling more than 100 employees from the systems business into the enclosures business within a four month time frame; developing work teams and continuous improvement teams; and preparing 600 employees for a corporate mock audit and external QMI audit for ISO 9000 registration.

In preparing for the ISO registration, employees needed to understand the background of ISO, the registration criteria, and their relationship to each individual's job. Lead assessors and implementation teams were required, and the training had to be interactive and address different learning styles. Training strategies included the use of a core curriculum, interactive learning, classroom sessions, and question and answer sessions. Management participation was essential. Leverage was obtained by combining training sessions when possible with other sites. Training was completed in just three weeks and led to successful completion of the audit and ISO 9002 registration.

Using the new strategy, the Training department was able to prioritize based on business goals and employee needs. Reduction in the number of training department personnel forced the utilization of a combination of training experts and manufacturing experts, resulting in quality training programs. Employees became involved in developing and assessing training programs. Cost savings were achieved by using existing corporate and industrial training programs and by leveraging training resources with other DEC sites having the same training requirements. Despite limited resources, the new strategy provided effective multi-faceted, multi-media training programs that synchronize with corporate programs and the employee needs.

3.7 MANAGEMENT

MANUFACTURING STRATEGY

Total Quality System

DEC's Enclosures Business maintains an integrated quality system linked to suppliers and customers that is designed to ensure product conformance to specifications. The system is compliant to the ISO 9002 standard, the applicable ISO 9000 series standard for the Enclosures Business. The quality system is composed of four interactive elements – execution, documentation, control, and assurance.

Execution involves providing the proper job tools so employees can effectively carry out their required actions.

Documentation in the form of standards, critical dimensions, and clear quality criteria is the media for describing the activities which must be executed to ensure quality and process control.

Control includes the techniques used to maintain the ability to produce products and services to quality standards such as training, SPC, trend analysis, and corrective action.

Assurance involves functions performed to assure management and customers that the quality system is effective. These functions include assessments, audits, inspections, communication, leadership, and continuous improvement.

A Quality Manager is responsible for ensuring that the quality system is effectively documented, implemented,

and maintained. This Quality Manager is assisted by a Management Review Team consisting of the Engineering Managers, a Quality Assurance Manager, Operations Managers, and the Purchasing Manager. The team meets weekly with the objective to identify quality problems or trends that need to be addressed and highlight positive accomplishments. Appropriate accountability and monitoring processes have been established to support the team. Data is drawn from corrective action reports, internal assessment reports, quality assurance reports, and vendor quality engineering reports.

The quality system is highly effective and has fostered a disciplined approach to manufacturing at the DEC Westfield site. It has been recognized by an independent international certification firm as meeting the requirements of ISO 9002 which has helped to competitively position the company in the world marketplace.

ISO 9000 Implementation and Registration

DEC made a corporate decision in 1990 to seek individual ISO 9000 registration for certain key manufacturing units, and the Westfield facility was one of 108 manufacturing sites targeted. A year-long effort was initiated at Westfield in April of 1991 to prepare for registration. Coincidentally, this was a time of dramatic changes as the facility was completely restructuring its business focus and also beginning a major reduction in personnel. Preparing for ISO 9000 registration helped to give discipline and focus to the emerging worldwide enclosures business during a turbulent transition period. It also provided the foundation for an effective quality system.

Leadership for the implementation came initially from the DEC corporate quality organization. It provided a four and a half day training course and served as consultants and coaches. The most difficult part was accomplished by the Westfield site personnel – turning an informal quality program into a quality system that would be well documented, demonstrable, effective, and maintained. The twelve month implementation effort culminated in an audit conducted by the Quality Management Institute in April 1992. The Institute issued the DEC Westfield plant Unconditional ISO 9002-1987 Registration effective May 1, 1992.

The implementation effort involved many key elements which created an effective total quality system. First, a formal quality manual was developed that described the quality system including the quality policy and quality plan. All employees attended formal training sessions to gain understanding of the ISO 9002 requirements and how they apply specifically to the enclosures business. An effective, centralized three-level closed loop corrective action system was established. Formal documentation was developed describing the activities which must be executed to ensure quality and process control. Formal quality system self audits were initiated on a monthly basis with results presented at the monthly operations meeting and formal corrective action requests generated as appropriate. Other actions included implementing a formal contract review process to balance actual ability to deliver with customer needs, establishment of a management review team independent of the business staff to monitor ongoing integrity of the quality system and timely corrective action closure, and weekly management reviews of the quality system by the business staff.

The implementation effort resulted in improved internal communications and with customers, more timely response to corrective action requests, and a clear quality policy understood by all employees. It produced a quality system that is documented, understood, and continually managed for improvement. Other benefits included reinforcement of a positive attitude toward the employees' responsibility for quality work and products, and a solid foundation to support ongoing Total Quality Management initiatives. The formal registration provided a sense of accomplishment at being certified by a well recognized third party audit firm, plus a real competitive advantage in the world marketplace.

The experience gained by DEC in achieving independent ISO registration of over 100 manufacturing sites has also provided a new business opportunity. DEC's corporate quality organization is marketing consulting services and training programs to companies seeking ISO certification.

Productivity Improvement Teams

Productivity Improvement Teams at DEC Westfield are empowered to focus on specific production areas to identify and implement productivity improvements. The emphasis of these teams is on timely implementation of solutions with support, as required, from upper management. The Productivity Improvement Team concept evolved during an effort to establish team building concepts and team problem solving to pursue specific productivity improvement initiatives. These efforts were part of DEC's continuous improvement program.

The teams are cross-functional and comprised of representatives from many disciplines. Gains are measured in terms of hours and/or dollars saved, cost avoidance, and labor productivity gains. Team members are selected by managers, representing functional disciplines such as process engineering, product engineering, planning, supervision, and coordinator. The team identifies and quantifies opportunities for improvement through discussions with area personnel and meets weekly to conduct planning and implementation. Resources are obtained outside the immediate group as necessary to complete the task.

Productivity improvement accomplishments at DEC Westfield include:

- Developing snap-on masks instead of the traditional tape masks used on parts to be painted. Typical masking operation times decreased from 15 minutes per part to three minutes per part, resulting in a savings of 4,000 hours per year.
- Optimizing the painting work flow by increasing line density and paint crew personnel. A 20% increase in crew personnel resulted in a 100% increase in output.
- Implementing a simple Kanban material storage system which reduced WIP, part shortages, and improved material flow. Eight hours per week were saved.
- Improving management of part numbers with the same color through the paint shop. Color changes were reduced 60%, resulting in less set-up and lower throughput cycle times.

DEC Westfield determined that productivity teams have a finite life. The initial energy and ideas bring about 80% of the gain in the first three months. Also, it discovered that a company needed to be prepared to face resistance to change. It also found that it had to accept that some ideas just do not work, and that successful ideas initiated by Productivity Improvement Teams have a good chance of becoming part of the standard way of business.

Employee Development Education Program

DEC Westfield has implemented an Employee Development Education Program that focuses on employees becoming certified in specialty areas of Purchasing Management, Quality Engineering, and Production and Inventory Control through nationally recognized organizations such as the National Association for Purchasing Management, the American Society for Quality Control and the American Productivity and Inventory Control Society. Many employees from Westfield have participated in the program since 1986, attaining various degrees of certification under these three association/societies.

The program compliments an existing DEC-wide employee education program, and offers an avenue of expanded education not readily attainable through academia. DEC corporate recognizes that self-development and improvement skills are vital to the business. The Westfield site recognized that valuable education programs are available through national societies and associations that fill the gap not provided by academia.

An Employee Development Education Program was formalized to take advantage of these educational opportunities. The Employee Development Education Program criteria centers around DEC Westfield's business goals that focus on obtaining business excellence, strengthening individual business knowledge and depth of basic operational disciplines, recognition of individuals demonstrating a thorough understanding of those disciplines, and raising the professional standards of those working within the Westfield environment. The program is available to all employees.

DEC Westfield and the individual participants have realized many benefits through this form of education including customer recognition of superior level of expertise and experience through the manufacturing environment; peer and industry recognition and credibility; confidence by DEC individuals to take actions resulting in outstanding manufacturing performance; and Westfield certified employees used by associations as instructors for on-site workshops. The most critical benefit to this program, however, is in the valuable assets it provided in the effort to improve the Enclosures Business competitive edge.

Employee Assistance Program

The human issue is a critical element in the DEC culture. As part of the effort to maintain a healthy work force, DEC Westfield established an Employee Assistance Program (EAP) to provide its employees professional services and referrals required to help resolve physical and emotional difficulties, substance abuse, family problems, and legal and financial concerns.

DEC Westfield recognizes that personal problems affect work performance and the employee, as well as the employee's family's life and well being. Employees may not always be aware of the seriousness of their problems and therefore may not seek professional help. Still other employees may know they need help but are not sure what to do about it. There is normally a direct correlation between problems and job performance. DEC realizes that offering the employee assistance to resolve these problems makes good business sense.

It is the company's philosophy to confidentially assist employees who may be experiencing personal problems. The EAP is a formalized program that provides this assistance. It compliments a comprehensive focus on health in the company that also includes on-site medical services and a fitness center. Key components of the EAP include easy employee access, family involvement, prevention education, confidentiality, program reporting and evaluating, professional staffing, and a strong external resource network. Unique elements of the EAP are its 24-hour emergency service, management training to look for behavior signs, formal and informal employee feedback, a knowledgeable and sophisticated program administration, and the specific tailoring to the employees and management.

The EAP is a well established program perceived as a valuable service by the employees and management of DEC. The EAP contributes to improved productivity, increased employee morale, reduced medical costs, decreased absenteeism and improved employer/employee relations.

PERSONNEL REQUIREMENTS

Indirect Labor Participation Program

The Indirect Labor Participation Program at DEC Westfield has been in operation since November 1991. Under the program, each indirect labor employee such as a manager or an engineer performs four hours per week in a direct labor operational position on the factory floor. This is in addition to the normal work week and duties of the employee. The purpose of the program is to develop better communication and understanding between the indirect and direct labor forces and provide opportunities for continuous improvement.

Scheduling of assignments is flexible, and most employees work at the same time each week. Work assignments are based on the interests and skills of the employee. The employees receive on-the-job training in their direct labor assignments, and all indirect labor personnel are required to maintain a skill card showing the training they have received for their direct labor assignments. Rather than sampling a broad range of jobs, most employees tend to become proficient in specific skill areas.

There has been general acceptance by the indirect labor force, and the program has been well received by the direct labor personnel and produced a number of benefits to the business. As a direct result of the interaction, managers and engineers are gaining a better understanding of manufacturing processes and opportunities for improvement. Communication between management and the operations work force has improved significantly.

One example of these benefits is the paint masking line. Operators on the paint masking line were aware of the inefficiencies of the masking process which was done manually using masking tape applied by hand. Their ideas for improving the process were not understood or implemented by management. It was not until management personnel were exposed to actually working on the masking line and performing the operations that they understood the ideas for improving the process. Suggestions by direct labor personnel for using mechanical masking were quickly implemented producing large and immediate improvements in cost and productivity.

Another benefit of the program is labor cost avoidance by gaining an additional four hours of direct labor per week from each indirect labor employee. This gain may be partially offset by reducing the time available for continuous improvement activities by indirect labor personnel. The overall net effect is positive.

DATA REQUIREMENTS

Information Systems and Technology

DEC Westfield's Information Management and Technology (IM&T) Department supports all aspects of the Worldwide Enclosures Business operations by providing and maintaining the systems and software to operate a seven-day, 24-hour computer environment. Capabilities include electronic mail linking all DEC employees worldwide and key external customers, CAD/CAM network linkages between the design groups, Electronic Data Interchange with major suppliers, complete office and business systems, and over 100 software packages. A broad array of systems including PCs, workstations, VAX, and UNIX based systems are supported and fully integrated into the business. The Westfield site supports over 600 users with 2000 accounts. Other operations supported by the IM&T department involve real time monitoring of the paint system and effluent for compliance with EPA/OSHA requirements plus downloading software through DNC to machinery on the factory floor.

Constant security monitoring is provided with the software SECURPAK and a full-time security manager. Formal contingency plans ensure uninterrupted systems support backed by a three shift support staff on call 24 hours a day. IM&T consultants work closely with engineering and operations to provide software training and office automation support as well as to serve as members of various productivity teams.

Centralized and comprehensive information systems management is critical to the success of operations at the DEC Westfield site. The IM&T department provides a reliable, predictable, and secure computing environment which is a foundation of the business.

SECTION 4
INFORMATION

4.1 DESIGN

DESIGN REQUIREMENTS

Standard Visual Aid for Material Finish

The process of material finishing was carefully reviewed when DEC Westfield found many of its customers rejecting products for cosmetic reasons even though they may have been functionally acceptable. This problem became the single most contributing factor for delayed manufacturing, missed shipments, and customer returns. DEC developed a visual aid standard to define the material finish requirements.

A panel of customers, supplier platers, and DEC personnel was established to standardize criteria for acceptance of material finishes. The customers demanded a higher quality material finish appearance to the internal sheet metal of their cabinet products. Traditionally, DEC did not consider minor appearance imperfections, especially internal to its cabinets, to be reason for rejection. Meeting and discussing their viewpoints assisted in solving the problem.

A photographic workmanship record and revision of DEC Westfield plating standards and reference was completed for each potential plating defect. This manual was used by both plating suppliers and DEC personnel. It provided a consistent and common understanding of cosmetic and functional plating requirements between customer, suppliers, and DEC.

As a result, DEC Westfield has found that there are now less rejects from supplier platers, reduced customer returns, more effective and consistent inspection, reduced manufacturing cycle time, and an improved plater supplier relationship.

DESIGN PROCESS

Six Sigma Manufacturing

DEC implemented a Six Sigma process of manufacturing control. There were several reasons that DEC instituted Six Sigma including difficulty in changing designs; difficulty in improving the manufacturing process after the product was in volume manufacturing; limited customer interface in the product introduction stage; customer dissatisfaction with the product quality; customer requirements not always being met; reducing time to market; and controlling cost.

The DEC Six Sigma process addresses these problems by setting a common goal for design, manufacturing, and the customer; recognizing the importance of integrated agreement at the conceptual stage of the product; providing a consistent measure of quality improvements; establishing clear goals; defining statistical measures of the product/process capabilities; and deriving data by SPC and problem solving techniques.

These criteria are slowly being implemented. This effort has resulted in more effective process capability studies, clearly defined requirements, easier implementation of design changes, and improved communication between design, manufacturing, and the customer.

CONFIGURATION CONTROL

Engineering Change Orders

To ensure timely implementation of engineering change orders (ECOs) and strengthen product configuration control, DEC Westfield has revised its process of issuing ECOs. The objective of this process is coordination among all key organizations to guarantee that the latest revision parts and products are being manufactured.

The process begins when the ECO is literally compared to the marked print for accuracy, and any discrepancies are immediately rectified. A check is also conducted to determine if any ECOs can be consolidated. The ECO and applicable print are then sent to the responsible engineer or designated responsible individual. ECOs are sent via electronic mail and marked prints are delivered in hard copy form. Impact statements are returned to the ECO department. These statements are generated by the responsible person who received the ECO, and the impact statements are evaluated with the assistance of production to determine the ECO implementation date. Finally, both electronic and hard copy files are maintained for all ECOs. Weekly reports are distributed containing all open ECOs and those with special problems. All information is kept current to ensure each report's accuracy.

This process has assured that revisions are updated within the revision tracking system upon first issue of all ECOs. Streamlining the ECO process has allowed Westfield to ensure timely implementation of ECOs and better serve its customer requirements.

4.2 FACILITIES

PRODUCTIVITY CENTER

Work Cell Teams

The DEC Worldwide Enclosures site instituted work cell teams in its production efforts. Goals of some of these cells were to reduce cycle time, reduce WIP inventory, and define the application of JIT Group Technology within the Enclosures Business.

The work cell teams employed strategies such as laying out the original equipment in close proximity while providing uninterrupted flow; utilizing a horseshoe shape to promote visibility; identifying products that share common routings and machines; replacing queues with Kanban control; and including press brake, insert installation and welding operations within the cell.

Results of this effort reduced cycle time on the production of parts within the cell by 80%, reduced WIP, improved material handling efforts and provided a successful application of Group Technology. Other work cell pilot projects have shown up to 60% set-up reduction time and should show the ability of aligned groups to manage their own work.

Continuous Improvement Teams

Numerous personnel within DEC Worldwide Enclosures have been trained in setting up and operating Continuous Improvement Teams (CITs) to improve the overall business operation. DEC recognizes that its employees are its biggest asset and that their ideas and suggestions are what will keep the company growing.

The teams normally consist of six to eight personnel and a facilitator – all have a common goal. A typical team includes production workers, their internal customers, and process engineering personnel. These members are empowered to identify a problem area and take corrective action to correct the problem. They meet regularly, document their meetings, and share the findings with other personnel in their work area.

By adjusting work schedules of the team members, intershift participation in the effort is accomplished. The focus of all of the teams is quality and by eliminating non-value added work, productivity is increased.

4.3 MANAGEMENT

MANUFACTURING STRATEGY

Manufacturing Resource Planning

The Manufacturing Resource Planning process defines the disciplines necessary to achieve the required production output consistent with the corporate business philosophy. At DEC Westfield, MRP II standards establish a basic discipline baseline for understanding and refining this process.

In November 1988, DEC Westfield products included electronic systems and module manufacturing and the facility was MRP II Class A certified. Since that time, the Westfield site has changed to the Worldwide Enclosure Business. Westfield reviewed its new business and recognized that elements of its manufacturing resource planning required modification and refining. MRP II philosophies were carried over into this new business.

Review of the MRP II Metrics continues regularly. Unnecessary metrics are eliminated and new metrics are added to tighten performance. Key process elements safeguarded at Westfield to ensure the successful use of MRP II concepts include top management planning, operations management planning, data base accuracy, and operations management execution. MRP II philosophy is well known and understood by the DEC Worldwide Enclosures Business, and it is successfully exhibiting commitment to and implementation of its MRP II process.

Team Evolution

The DEC Westfield operation has undergone a basic change in management philosophy from a traditional organizational structure with strict reporting lines of authority to a participatory management style. This change began several years ago and stemmed from a recognition that productivity had topped out under the traditional management philosophy. During the same period, the Westfield facility experienced a 50% reduction in personnel resulting from downsizing and a major shift in product lines transferring all but the Enclosures Business to other divisions.

The evolution of this management shift began with the establishment of a Leadership Program aimed at educating the entire work force in how to function in groups. Training was provided to groups of 30, selected from a cross section of management and operators. After the initial course of training, a supervisor development effort was implemented to direct the focus toward the group most impacted by the changing philosophy.

These programs were developed with the assistance of an outside consultant firm. Training was stopped during the downsizing and transfer of product lines, but within the past year the evolution has resumed at an increased pace. The earlier training in participatory group activities provided the foundation for development of a variety of team activities which are continuing to evolve. Some of these activities have included Productivity Teams, Technology Teams, Commodity Teams, Cell Teams, Cycle Time Reduction Teams, and Continuous Improvement Teams.

These teams have focused on composition and operations and are experimenting with organizational and reporting changes. The team strategy is designed to increase involvement, spread opportunity and decision making, develop a mixture of leadership and consensus, and balance autonomy and participation. It is anticipated that these efforts will produce different group structures that are determined by knowledge and skill, resulting in a flatter, functionally diverse management style.

Cycle Time Reduction Program

Management at DEC Westfield recognized a need to improve the efficiency of manufacturing processes in all areas of the plant to enhance its competitive position and attain best-in-class status. The Cycle Time Reduction Program was initiated to address this need and achieve the goals of reduced cost, increased customer satisfaction, and overall improvement in the working environment. Expected benefits include reduced inventory levels, improved efficiency and productivity, improved quality, improved delivery performance, reduced TTM, improved flexibility, improved communication, and enhanced work environment.

The program is new having been in operation less than a year. A full time program manager was assigned in July 1992, and the program was elevated to one of the major priorities of the business. A primary goal of the program is to accomplish a dramatic reduction in cycle time without impacting the ability of the plant to function normally during the transition period. Implementation of improvements will be accomplished using a coordinated approach that builds on many of the activities already underway within the plant.

Application of well known techniques for reducing process cycle time such as JIT and Total Quality Control principles will be the basis of the project. Initiatives are underway in the cycle time reduction metrics, process layout, group technology, setup reduction and avoidance, packaging and material handling, material procurement and distribution, barcoding and paperwork, scheduling, plated material, and human resources impact. Teams have been formed in each of these initiative areas.

The effort is managed by the program manager who is responsible for developing and communicating goals, scheduling, coordinating satellite teams, reporting status, resource planning, and central focus. Execution will be by project teams with the program manager responsible for coordinating activities of the teams to ensure that they are working toward common goals. In some cases, the teams were in existence and assigned to work with the program.

The program is already achieving results. Corporate expectations for the program are ambitious. A goal of 30% reduction in cycle time per year beginning in fiscal 1993 has been established.

APPENDIX A

TABLE OF ACRONYMS

ACRONYM	DEFINITION
AIM	Automated Industrial Monitoring
CIT	Continuous Improvement Team
DEC	Digital Equipment Corporation
EAP	Employee Assistance Program
ECO	Engineering Change Order
IM&T	Information Management and Technology
QTA	Quick Turnaround
RPP	Rapid Pilot Production
SSMP	Supplier Systems Management Program
STS	Ship To Stock
TTM	Time To Market
VOC	Volatile Organic Compound

APPENDIX B

BMP SURVEY TEAM

NAME	ACTIVITY	FUNCTION
Larry Robertson (812) 854-5336	**Crane Division** **Naval Surface Warfare Center** Crane, IN	**Survey Chairman**
Amy Scanlan (206) 679-9008	**BMP Representative** Oak Harbor, WA	**Technical Writer**
Nick Keller (812) 854-5331	**Crane Division** **Naval Surface Warfare Center** Crane, IN	**Team Leader** Design/Test
Robert Motyl (619) 553-1386	**NCCOSC** San Diego, CA	
Pat Loyacona (814) 269-2550	**Concurrent Technologies Corporation** Johnstown, PA	
Bob Jenkins (703) 746-3553	**NAVSEA** Washington, DC	**Team Leader** Production/Facilities
Ken Shake (502) 364-6790	**Naval Ordnance Station** Louisville, KY	
Don Hill (317) 353-7221	**Aircraft Division - Indianapolis** **Naval Air Warfare Center** Indianapolis, IN	
Rick Purcell (703) 271-9055	**BMP Representative** Washington, DC	**Team Leader** Management/Logistics
Larry Halbig (317) 353-3838	**Aircraft Division - Indianapolis** **Naval Air Warfare Center** Indianapolis, IN	

APPENDIX C

NAVY CENTERS OF EXCELLENCE

Automated Manufacturing Research Facility

(301) 975-3414

The Automated Manufacturing Research Facility (AMRF) – a National Center of Excellence – is a research test bed at the National Institute of Standards and Technology located in Gaithersburg, Maryland. The AMRF produces technical results and transfers them to the Navy and industry to solve problems of automated manufacturing. The AMRF supports the technical work required for developing industry standards for automated manufacturing. It is a common ground where industry, academia, and government work together to address pressing national needs for increased quality, greater flexibility, reduced costs, and shorter manufacturing cycle times. These needs drive the adoption of new computer-integrated manufacturing technology in both civilian and defense sectors. The AMRF is meeting the challenge of integrating these technologies into practical, working manufacturing systems.

Electronics Manufacturing Productivity Facility

(317) 226-5607

Located in Indianapolis, Indiana, the Electronics Manufacturing Productivity Facility (EMPF) is a National Center of Excellence established to advance state-of-the-art electronics and to increase productivity in electronics manufacturing. The EMPF works with industry, academia, and government to identify, develop, transfer, and implement innovative electronics manufacturing technologies, processes, and practices. The EMPF conducts applied research, development, and proof-of-concept electronics manufacturing and design technologies, processes, and practices. It also seeks to improve education and training curricula, instruction, and necessary delivery methods. In addition, the EMPF is striving to identify, implement, and promote new electronics manufacturing technologies, processes, materials, and practices that will eliminate or reduce damage to the environment.

National Center for Excellence in Metalworking Technology

(814) 269-2420

The National Center for Excellence in Metalworking Technology (NCEMT) is located in Johnstown, Pennsylvania and is operated by Concurrent Technologies Corporation (CTC), a subsidiary of the University of Pittsburgh Trust. In support of the NCEMT mission, CTC's primary focus includes working with government and industry to develop improved manufacturing technologies including advanced methods, materials, and processes, and transferring those technologies into industrial applications. CTC maintains capabilities in discrete part design, computerized process analysis and modeling, environmentally compliant manufacturing processes, and the application of advanced information science technologies to product and process integration.

Center of Excellence for Composites Manufacturing Technology

(414) 947-8900

The Center of Excellence for Composites Manufacturing Technology (CECMT), a national resource, is located in Kenosha, Wisconsin. Established as a cooperative effort between government and industry to develop and disseminate this technology, CECMT ensures that robust processes and products using new composites are available to manufacturers. CECMT is operated by the Great Lakes Composites Consortium. It represents a collaborative approach to provide effective advanced composites technology that can be introduced into industrial processes in a timely manner. Fostering manufacturing capabilities for composites manufacturing will enable the U.S. to achieve worldwide prominence in this critical technology.

APPENDIX D

PROGRAM MANAGERS' WORKSTATION

The Program Managers' Workstation (PMWS) is a series of expert systems that provides the user with information on how to manage a program, address technical risk assessment, and find solutions that industry leaders are using to reduce technical risk and improve quality and productivity. This system is divided into four main components; KNOW-HOW, Technical Risk Identification and Mitigation System (TRIMS), BMP Database, and Best Manufacturing Practices Network (BMPNET).

- **KNOW-HOW** is an intelligent, automated method that turns "Handbooks" into expert systems, or digitized text. It provides rapid access to information in existing handbooks including Acquisition Streamlining, Non-Development Items, Value Engineering, NAVSO P-6071 (Best Practices Manual), and the DoD 5000 series documents.

- **TRIMS** is based on DoD 4245.7-M (the transition templates), NAVSO P-6071 and DoD 5000. It identifies and ranks the high risk areas in a program. TRIMS conducts a full range of risk assessments throughout the acquisition process so corrective action can be initiated before risks develop into problems. It also tracks key project documentation from concept through production including goals, responsible personnel, and next action dates for future activities in the development and acquisition process.

- The **BMP DATABASE** draws information from industry, government, and the academic communities to include documented and proven best practices in design, test, production, facilities, management, and logistics. Each practice in the database has been observed and verified by a team of experienced government engineers. All information gathered from BMP surveys is included in the BMP DATABASE, including this survey report.

- **BMPNET** provides communication between all PMWS users. Features include downloading of all programs, E-mail, file transfer, help "lines", Special Interest Groups (SIGs), electronic conference rooms and much more. Through BMPNET, IBM or compatible PC's and Macintosh computers can run all PMWS programs.

- To access **BMPNET** efficiently, users need a special modem program. This program can be obtained by calling the BMPNET through your communications software by dialing (703) 538-7697 for 2,400 baud modems and (703) 538-7267 for 9,600 baud and 14.4 kb modems. BMPNET operates with any standard modem program that can emulate a VT-100/200 terminal. When asked for a user profile, type: Download <return>. This will automatically start the Download of the PC DOS version of our special modem program. You can then call back using this program and access all BMPNET functions (except receiving mail). The General User account is:

  USER PROFILE: BMPNET

  USER I.D.: BMP

  Password: BMPNET

If you desire your own personal account (so that you may receive E-Mail), just E-Mail a request to either Ernie Renner (BMP Director) or Brian Willoughby (CSC Program Manager).

APPENDIX E

PREVIOUSLY COMPLETED SURVEYS

BMP surveys have been conducted at the companies listed below. Information gathered from all BMP surveys is included in the Best Manufacturing Practices Network (BMPNET). Additionally, a calendar of events and other relevant information are included on the BMPNET. Copies of older survey reports may be obtained through DTIC or by accessing the BMPNET. Requests for copies of recent survey reports or inquiries regarding the BMPNET may be directed to:

Best Manufacturing Practices Program
2101 Crystal Plaza Arcade
Suite 271
Arlington, VA 22202
FAX: (703) 696-8480

COMPANIES SURVEYED

Litton
Guidance & Control Systems Division
Woodland Hills, CA
October 1985 and February 1991

Texas Instruments
Defense Systems & Electronics Group
Lewisville, TX
May 1986 and November 1991

Harris Corporation
Government Support Systems Division
Syosset, NY
September 1986

Control Data Corporation
Government Systems Division
(Computing Devices International)
Minneapolis, MN
December 1986

ITT
Avionics Division
Clifton, NJ
September 1987

UNISYS
Computer Systems Division
(Paramax)
St. Paul, MN
November 1987

General Dynamics
Fort Worth Division
Fort Worth, TX
May 1988

Honeywell, Incorporated
Undersea Systems Division
(Alliant Tech Systems, Inc.)
Hopkins, MN
January 1986

General Dynamics
Pomona Division
Pomona, CA
August 1986

IBM Corporation
Federal Systems Division
Owego, NY
October 1986

Hughes Aircraft Company
Radar Systems Group
Los Angeles, CA
January 1987

Rockwell International Corporation
Collins Defense Communications
Cedar Rapids, IA
October 1987

Motorola
Government Electronics Group
Scottsdale, AZ
March 1988

Texas Instruments
Defense Systems & Electronics Group
Dallas, TX
June 1988

Hughes Aircraft Company
Missile Systems Group
Tucson, AZ
August 1988

Litton
Data Systems Division
Van Nuys, CA
October 1988

McDonnell-Douglas Corporation
McDonnell Aircraft Company
St. Louis, MO
January 1989

Litton
Applied Technology Division
San Jose, CA
April 1989

Standard Industries
LaMirada, CA
June 1989

Teledyne Industries Incorporated
Electronics Division
Newbury Park, CA
July 1989

Lockheed Corporation
Missile Systems Division
Sunnyvale, CA
August 1989

General Electric
Naval & Drive Turbine Systems
Fitchburg, MA
October 1989

TRICOR Systems, Incorporated
Elgin, IL
November 1989

TRW
Military Electronics and Avionics Division
San Diego, CA
March 1990

Boeing Aerospace & Electronics
Corinth, TX
May 1990

Bell Helicopter
Textron, Inc.
Fort Worth, TX
October 1988

GTE
C^3 Systems Sector
Needham Heights, MA
November 1988

Northrop Corporation
Aircraft Division
Hawthorne, CA
March 1989

Litton
Amecom Division
College Park, MD
June 1989

Engineered Circuit Research, Incorporated
Milpitas, CA
July 1989

Lockheed Aeronautical Systems Company
Marietta, GA
August 1989

Westinghouse
Electronic Systems Group
Baltimore, MD
September 1989

Rockwell International Corporation
Autonetics Electronics Systems
Anaheim, CA
November 1989

Hughes Aircraft Company
Ground Systems Group
Fullerton, CA
January 1990

MechTronics of Arizona, Inc.
Phoenix, AZ
April 1990

Technology Matrix Consortium
Traverse City, MI
August 1990

Textron Lycoming
Stratford, CT
November 1990

Naval Avionics Center
Indianapolis, IN
June 1991

Kurt Manufacturing Co.
Minneapolis, MN
July 1991

Raytheon Missile Systems Division
Andover, MA
August 1991

Tandem Computers
Cupertino, CA
January 1992

Conax Florida Corporation
St. Petersburg, FL
May 1992

Hewlett-Packard
Palo Alto Fabrication Center
Palo Alto, CA
June 1992

Norden Systems, Inc.
Norwalk, CT
May 1991

United Electric Controls
Watertown, MA
June 1991

MagneTek Defense Systems
Anaheim, CA
August 1991

AT&T Federal Systems Advanced Technologies
and AT&T Bell Laboratories
Greensboro, NC and Whippany, NJ
September 1991

Charleston Naval Shipyard
Charleston, SC
April 1992

Texas Instruments
Semiconductor Group
Military Products
Midland, TX
June 1992

Watervliet U.S. Army Arsenal
Watervliet, New York
July 1992